

1 CLAIMS

2 What is claimed is:

- 3 1. An optical device, comprising:
4 a transmission optical waveguide; and
5 an optical device component transverse-coupled to the transmission optical waveguide so as
6 to enable optical signal power transfer therebetween,
7 the transmission optical waveguide being adapted for at least one of receiving optical signal
8 power from an optical signal transmission system and transmitting optical signal power
9 to the optical signal transmission system,
10 the optical device component including a laterally-confined multi-layer dispersion-
11 engineered waveguide structure, the multi-layer waveguide structure including at least
12 one multi-layer reflector stack,
13 the optical device component being transverse-coupled to the transmission optical
14 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
15 being adapted for enabling modal-index-matching between the transmission optical
16 waveguide and the optical device component.
- 17 2. The optical device of Claim 1, the transmission optical waveguide being a low-index optical
18 waveguide.
- 19 3. The optical device of Claim 2, the transmission optical waveguide being a fiber-optic
20 transmission waveguide, the fiber-optic transmission waveguide being adapted for
21 transverse-coupling with the optical device component.
- 22 4. The optical device of Claim 3, the transmission fiber-optic waveguide being adapted for at
23 least one of receiving optical signal power form a fiber-optic telecommunications system
24 and transmitting optical signal power to a fiber-optic telecommunications system.
- 25 5. An optical device, comprising:
26 a transmission optical waveguide; and
27 an optical device component transverse-coupled to the transmission optical waveguide so as
28 to enable optical signal power transfer therebetween,

1 the transmission optical waveguide being adapted for at least one of receiving optical signal
 2 power from an optical signal transmission system and transmitting optical signal power
 3 to the optical signal transmission system,

4 the optical device component including a laterally-confined multi-layer dispersion-
 5 engineered waveguide structure, the multi-layer waveguide structure including at least
 6 one multi-layer reflector stack,

7 the optical device component being transverse-coupled to the transmission optical
 8 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
 9 being adapted for enabling modal-index-matching between the transmission optical
 10 waveguide and the optical device component,

11 the transmission fiber-optic waveguide including a fiber-optic-taper segment, the fiber-
 12 optic-taper segment being transverse-coupled to the optical device component.

13 6. An optical device, comprising:

14 a transmission optical waveguide; and

15 an optical device component transverse-coupled to the transmission optical waveguide so as
 16 to enable optical signal power transfer therebetween,

17 the transmission optical waveguide being adapted for at least one of receiving optical signal
 18 power from an optical signal transmission system and transmitting optical signal power
 19 to the optical signal transmission system,

20 the optical device component including a laterally-confined multi-layer dispersion-
 21 engineered waveguide structure, the multi-layer waveguide structure including at least
 22 one multi-layer reflector stack,

23 the optical device component being transverse-coupled to the transmission optical
 24 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
 25 being adapted for enabling modal-index-matching between the transmission optical
 26 waveguide and the optical device component,

27 the transmission optical waveguide being a low-index planar lightwave transmission optical
 28 waveguide.

29 7. An optical device, comprising:

30 a transmission optical waveguide; and

1 an optical device component transverse-coupled to the transmission optical waveguide so as
2 to enable optical signal power transfer therebetween,
3 the transmission optical waveguide being adapted for at least one of receiving optical signal
4 power from an optical signal transmission system and transmitting optical signal power
5 to the optical signal transmission system,
6 the optical device component including a laterally-confined multi-layer dispersion-
7 engineered waveguide structure, the multi-layer waveguide structure including at least
8 one multi-layer reflector stack,
9 the optical device component being transverse-coupled to the transmission optical
10 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
11 being adapted for enabling modal-index-matching between the transmission optical
12 waveguide and the optical device component,
13 the multi-layer waveguide structure being adapted for passive modal-index-matching
14 between the transmission optical waveguide and the multi-layer waveguide structure.

- 15 8. The optical device of Claim 7, the multi-layer waveguide structure including high-index
16 material, the transmission optical waveguide being a low-index transmission optical
17 waveguide.
- 18 9. An optical device, comprising:
19 a transmission optical waveguide; and
20 an optical device component transverse-coupled to the transmission optical waveguide so as
21 to enable optical signal power transfer therebetween,
22 the transmission optical waveguide being adapted for at least one of receiving optical signal
23 power from an optical signal transmission system and transmitting optical signal power
24 to the optical signal transmission system,
25 the optical device component including a laterally-confined multi-layer dispersion-
26 engineered waveguide structure, the multi-layer waveguide structure including at least
27 one multi-layer reflector stack,
28 the optical device component being transverse-coupled to the transmission optical
29 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure

1 being adapted for enabling modal-index-matching between the transmission optical
2 waveguide and the optical device component,
3 the multi-layer waveguide structure being adapted for passive modal-index-matching
4 between the transmission optical waveguide and the multi-layer waveguide structure,
5 the multi-layer waveguide including high-index material, the transmission optical
6 waveguide being a transmission fiber-optic waveguide including a fiber-optic-taper
7 segment, the fiber-optic-taper segment being transverse-coupled to the multi-layer
8 waveguide structure.

9 10. An optical device, comprising:

10 a transmission optical waveguide; and
11 an optical device component transverse-coupled to the transmission optical waveguide so as
12 to enable optical signal power transfer therebetween,
13 the transmission optical waveguide being adapted for at least one of receiving optical signal
14 power from an optical signal transmission system and transmitting optical signal power
15 to the optical signal transmission system,
16 the optical device component including a laterally-confined multi-layer dispersion-
17 engineered waveguide structure, the multi-layer waveguide structure including at least
18 one multi-layer reflector stack,
19 the optical device component being transverse-coupled to the transmission optical
20 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
21 being adapted for enabling modal-index-matching between the transmission optical
22 waveguide and the optical device component,
23 the multi-layer waveguide structure being adapted for passive modal-index-matching
24 between the transmission optical waveguide and the multi-layer waveguide structure,
25 the multi-layer waveguide structure including high-index material, the transmission optical
26 waveguide being a low-index planar lightwave transmission optical waveguide.

27 11. An optical device, comprising:

28 a transmission optical waveguide; and
29 an optical device component transverse-coupled to the transmission optical waveguide so as
30 to enable optical signal power transfer therebetween,

the transmission optical waveguide being adapted for at least one of receiving optical signal power from an optical signal transmission system and transmitting optical signal power to the optical signal transmission system,

the optical device component including a laterally-confined multi-layer dispersion-engineered waveguide structure, the multi-layer waveguide structure including at least one multi-layer reflector stack,

the optical device component being transverse-coupled to the transmission optical waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure being adapted for enabling modal-index-matching between the transmission optical waveguide and the optical device component,

the multi-layer waveguide structure being adapted for passive modal-index-matching

between the transmission optical waveguide and the multi-layer waveguide structure,

the multi-layer waveguide structure being adapted for integration into an integrated optical device, the multi-layer waveguide structure being adapted for substantially completely transferring optical signal power between the transmission optical waveguide and the multi-layer waveguide structure, the multi-layer waveguide structure being thereby adapted to function as at least one of a passive input coupler and a passive output coupler between the transmission optical waveguide and the integrated optical device.

12. An optical device, comprising:

a transmission optical waveguide; and

an optical device component transverse-coupled to the transmission optical waveguide so as to enable optical signal power transfer therebetween,

the transmission optical waveguide being adapted for at least one of receiving optical signal power from an optical signal transmission system and transmitting optical signal power to the optical signal transmission system,

the optical device component including a laterally-confined multi-layer dispersion-engineered waveguide structure, the multi-layer waveguide structure including at least one multi-layer reflector stack,

the optical device component being transverse-coupled to the transmission optical waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure

1 being adapted for enabling modal-index-matching between the transmission optical
2 waveguide and the optical device component,
3 the multi-layer waveguide structure including an active layer, the active layer including at
4 least one of an electro-active layer and a non-linear-optical layer, the multi-layer
5 waveguide structure being adapted so that varying a control signal applied to the active
6 layer results in at least one of varying optical loss and varying modal-index for the
7 multi-layer waveguide structure.

8 13. The optical device of Claim 12, the multi-layer waveguide structure including at least one
9 electro-active layer, the electro-active layer including at least one of an electro-optic layer
10 and an electro-absorptive layer, the multi-layer waveguide structure including a pair of
11 electrical contact layers with the electro-active layer therebetween, the control signal being
12 an electronic control signal applied through the electrical contact layers.

13 14. The optical device of Claim 12, the multi-layer waveguide structure including at least one
14 non-linear-optical layer, the control signal being an optical control signal applied to the non-
15 linear-optical layer.

16 15. The optical device of Claim 12, the multi-layer waveguide structure including high-index
17 material, the transmission optical waveguide being a low-index transmission optical
18 waveguide, the multi-layer waveguide structure being adapted for active modal-index-
19 matching with the low-index transmission optical waveguide in response to the control
20 signal.

21 16. An optical device, comprising:
22 a transmission optical waveguide; and
23 an optical device component transverse-coupled to the transmission optical waveguide so as
24 to enable optical signal power transfer therebetween,
25 the transmission optical waveguide being adapted for at least one of receiving optical signal
26 power from an optical signal transmission system and transmitting optical signal power
27 to the optical signal transmission system,

1 the optical device component including a laterally-confined multi-layer dispersion-
 2 engineered waveguide structure, the multi-layer waveguide structure including at least
 3 one multi-layer reflector stack,
 4 the optical device component being transverse-coupled to the transmission optical
 5 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
 6 being adapted for enabling modal-index-matching between the transmission optical
 7 waveguide and the optical device component,
 8 the multi-layer waveguide structure including an active layer, the active layer including at
 9 least one of an electro-active layer and a non-linear-optical layer, the multi-layer
 10 waveguide structure being adapted so that varying a control signal applied to the active
 11 layer results in at least one of varying optical loss and varying modal-index for the
 12 multi-layer waveguide structure,
 13 the multi-layer waveguide including high-index material, the transmission optical
 14 waveguide being a transmission fiber-optic waveguide including a fiber-optic-taper
 15 segment, the fiber-optic-taper segment being transverse-coupled to the multi-layer
 16 waveguide structure, the multi-layer waveguide structure being adapted for active
 17 modal-index-matching with the fiber-optic-taper segment in response to the control
 18 signal.

19 17. An optical device, comprising:

20 a transmission optical waveguide; and
 21 an optical device component transverse-coupled to the transmission optical waveguide so as
 22 to enable optical signal power transfer therebetween,
 23 the transmission optical waveguide being adapted for at least one of receiving optical signal
 24 power from an optical signal transmission system and transmitting optical signal power
 25 to the optical signal transmission system,
 26 the optical device component including a laterally-confined multi-layer dispersion-
 27 engineered waveguide structure, the multi-layer waveguide structure including at least
 28 one multi-layer reflector stack,
 29 the optical device component being transverse-coupled to the transmission optical
 30 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure

1 being adapted for enabling modal-index-matching between the transmission optical
 2 waveguide and the optical device component,
 3 the multi-layer waveguide structure including an active layer, the active layer including at
 4 least one of an electro-active layer and a non-linear-optical layer, the multi-layer
 5 waveguide structure being adapted so that varying a control signal applied to the active
 6 layer results in at least one of varying optical loss and varying modal-index for the
 7 multi-layer waveguide structure,
 8 the multi-layer waveguide structure including high-index material, the transmission optical
 9 waveguide being a low-index planar lightwave transmission optical waveguide, the
 10 multi-layer waveguide structure being adapted for active modal-index-matching with
 11 the low-index planar lightwave transmission optical waveguide in response to the
 12 control signal.

- 13 18. An optical device, comprising:
 14 a transmission optical waveguide; and
 15 an optical device component transverse-coupled to the transmission optical waveguide so as
 16 to enable optical signal power transfer therebetween,
 17 the transmission optical waveguide being adapted for at least one of receiving optical signal
 18 power from an optical signal transmission system and transmitting optical signal power
 19 to the optical signal transmission system,
 20 the optical device component including a laterally-confined multi-layer dispersion-
 21 engineered waveguide structure, the multi-layer waveguide structure including at least
 22 one multi-layer reflector stack,
 23 the optical device component being transverse-coupled to the transmission optical
 24 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
 25 being adapted for enabling modal-index-matching between the transmission optical
 26 waveguide and the optical device component,
 27 the multi-layer waveguide structure including an active layer, the active layer including at
 28 least one of an electro-active layer and a non-linear-optical layer, the multi-layer
 29 waveguide structure being adapted so that varying a control signal applied to the active

1 layer results in at least one of varying optical loss and varying modal-index for the
2 multi-layer waveguide structure,
3 the multi-layer waveguide structure being adapted for integration into an integrated optical
4 device, the multi-layer waveguide structure being adapted for substantially modal-
5 index-matching with the transmission optical waveguide in response to the control
6 signal so as to substantially completely transfer optical signal power between the
7 transmission optical waveguide and the multi-layer waveguide structure in response to
8 the control signal, the multi-layer waveguide structure being thereby adapted for
9 functioning as at least one of an active input coupler and an active output coupler
10 between the transmission optical waveguide and the integrated optical device.

11 19. An optical device, comprising:

12 a transmission optical waveguide; and
13 an optical device component transverse-coupled to the transmission optical waveguide so as
14 to enable optical signal power transfer therebetween,
15 the transmission optical waveguide being adapted for at least one of receiving optical signal
16 power from an optical signal transmission system and transmitting optical signal power
17 to the optical signal transmission system,
18 the optical device component including a laterally-confined multi-layer dispersion-
19 engineered waveguide structure, the multi-layer waveguide structure including at least
20 one multi-layer reflector stack,
21 the optical device component being transverse-coupled to the transmission optical
22 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
23 being adapted for enabling modal-index-matching between the transmission optical
24 waveguide and the optical device component,
25 the multi-layer waveguide structure including an active layer, the active layer including at
26 least one of an electro-active layer and a non-linear-optical layer, the multi-layer
27 waveguide structure being adapted so that varying a control signal applied to the active
28 layer results in at least one of varying optical loss and varying modal-index for the
29 multi-layer waveguide structure,

1 the multi-layer waveguide structure being adapted for substantially completely transferring
2 optical signal power between the transmission optical waveguide and the multi-layer
3 waveguide structure in response to a first control signal level, the multi-layer waveguide
4 structure being adapted for substantially preventing optical signal power transfer
5 between the transmission optical waveguide and the multi-layer waveguide structure in
6 response to a second control signal level, the optical device being thereby adapted for
7 functioning as an optical switch.

8 20. An optical device, comprising:

9 a transmission optical waveguide; and

10 an optical device component transverse-coupled to the transmission optical waveguide so as
11 to enable optical signal power transfer therebetween,

12 the transmission optical waveguide being adapted for at least one of receiving optical signal
13 power from an optical signal transmission system and transmitting optical signal power
14 to the optical signal transmission system,

15 the optical device component including a laterally-confined multi-layer dispersion-
16 engineered waveguide structure, the multi-layer waveguide structure including at least
17 one multi-layer reflector stack,

18 the optical device component being transverse-coupled to the transmission optical
19 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
20 being adapted for enabling modal-index-matching between the transmission optical
21 waveguide and the optical device component,

22 the multi-layer waveguide structure including an active layer, the active layer including at
23 least one of an electro-active layer and a non-linear-optical layer, the multi-layer
24 waveguide structure being adapted so that varying a control signal applied to the active
25 layer results in at least one of varying optical loss and varying modal-index for the
26 multi-layer waveguide structure,

27 the multi-layer waveguide structure being adapted for allowing substantially maximal
28 transmission of optical signal power through the transmission optical waveguide in
29 response to a first control signal level, the multi-layer waveguide structure being
30 adapted allowing substantially minimal transmission of optical signal power through the

1 transmission optical waveguide in response to a second control signal level, the multi-
2 layer waveguide structure being adapted for allowing an intermediate transmission level
3 of optical signal power through the transmission optical waveguide in response to an
4 intermediate control signal level, the optical device being thereby adapted for
5 functioning as at least one of an optical modulator and a variable optical attenuator.

6 21. The optical device of Claim 20, the multi-layer waveguide structure being adapted for
7 exhibiting varying modal-index in response to varying control signal level.

8 22. The optical device of Claim 20, the multi-layer waveguide structure being adapted for
9 exhibiting varying optical loss in response to varying control signal level.

10 23. An optical device, comprising:

11 a transmission optical waveguide; and

12 an optical device component transverse-coupled to the transmission optical waveguide so as
13 to enable optical signal power transfer therebetween,

14 the transmission optical waveguide being adapted for at least one of receiving optical signal
15 power from an optical signal transmission system and transmitting optical signal power
16 to the optical signal transmission system,

17 the optical device component including a laterally-confined multi-layer dispersion-
18 engineered waveguide structure, the multi-layer waveguide structure including at least
19 one multi-layer reflector stack,

20 the optical device component being transverse-coupled to the transmission optical
21 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
22 being adapted for enabling modal-index-matching between the transmission optical
23 waveguide and the optical device component,
24 the multi-layer waveguide structure being positioned on a substrate, layers of the multi-layer
25 waveguide structure being substantially parallel to the substrate.

26 24. The optical device of Claim 23, the multi-layer reflector stack comprising a distributed
27 Bragg reflector stack.

28 25. The optical device of Claim 23, the multi-layer waveguide structure being fabricated at least
29 in part by deposition of layers on the substrate.

- 1 26. The optical device of Claim 23, the multi-layer waveguide structure including a single
2 multi-layer reflector stack, the multi-layer waveguide structure being thereby adapted for
3 guiding a surface-guided optical mode.
- 4 27. The optical device of Claim 23, the multi-layer waveguide structure including two multi-
5 layer reflector stacks and a core layer therebetween, the multi-layer waveguide structure
6 being thereby adapted for guiding an optical mode along the core layer.
- 7 28. An optical device, comprising:
8 a transmission optical waveguide; and
9 an optical device component transverse-coupled to the transmission optical waveguide so as
10 to enable optical signal power transfer therebetween,
11 the transmission optical waveguide being adapted for at least one of receiving optical signal
12 power from an optical signal transmission system and transmitting optical signal power
13 to the optical signal transmission system,
14 the optical device component including a laterally-confined multi-layer dispersion-
15 engineered waveguide structure, the multi-layer waveguide structure including at least
16 one multi-layer reflector stack,
17 the optical device component being transverse-coupled to the transmission optical
18 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
19 being adapted for enabling modal-index-matching between the transmission optical
20 waveguide and the optical device component,
21 the multi-layer waveguide structure being positioned on a substrate, layers of the multi-layer
22 waveguide structure being substantially parallel to the substrate,
23 the multi-layer waveguide structure including a ridge-like waveguide structure protruding
24 from the substrate formed by spatially-selective removal of material of lateral portions
25 of the multi-layer waveguide structure.
- 26 29. The optical device of Claim 28, the material being removed substantially completely down
27 to the substrate.
- 28 30. The optical device of Claim 28, the material being only partially removed.

- 1 31. The optical device of Claim 28, the material being removed substantially symmetrically
2 from lateral portions of the multi-layer waveguide structure.
- 3 32. The optical device of Claim 28, the material being removed asymmetrically from lateral
4 portions of the multi-layer waveguide structure.
- 5 33. The optical device of Claim 28, the transmission optical waveguide being transverse-
6 coupled at a side surface of the multi-layer waveguide structure.
- 7 34. The optical device of Claim 28, the transmission optical waveguide being transverse-
8 coupled at a top surface of the multi-layer waveguide structure.
- 9 35. An optical device, comprising:
10 a transmission optical waveguide; and
11 an optical device component transverse-coupled to the transmission optical waveguide so as
12 to enable optical signal power transfer therebetween,
13 the transmission optical waveguide being adapted for at least one of receiving optical signal
14 power from an optical signal transmission system and transmitting optical signal power
15 to the optical signal transmission system,
16 the optical device component including a laterally-confined multi-layer dispersion-
17 engineered waveguide structure, the multi-layer waveguide structure including at least
18 one multi-layer reflector stack,
19 the optical device component being transverse-coupled to the transmission optical
20 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
21 being adapted for enabling modal-index-matching between the transmission optical
22 waveguide and the optical device component,
23 the multi-layer waveguide structure being positioned on a substrate, layers of the multi-layer
24 waveguide structure being substantially parallel to the substrate,
25 at least one layer of the multi-layer waveguide structure being provided with a lateral lower-
26 index portion.
- 27 36. The optical device of Claim 35, the lateral lower-index portion being provided on only one
28 side of the multi-layer waveguide structure.

1 37. The optical device of Claim 35, the lateral lower-index portion being provided on both sides
2 of the multi-layer waveguide structure.

3 38. The optical device of Claim 35, the lateral lower-index portion being provided by physical
4 modification of at least one lateral portion of at least one layer.

5 39. An optical device, comprising:

6 a transmission optical waveguide; and

7 an optical device component transverse-coupled to the transmission optical waveguide so as
8 to enable optical signal power transfer therebetween,

9 the transmission optical waveguide being adapted for at least one of receiving optical signal
10 power from an optical signal transmission system and transmitting optical signal power
11 to the optical signal transmission system,

12 the optical device component including a laterally-confined multi-layer dispersion-
13 engineered waveguide structure, the multi-layer waveguide structure including at least
14 one multi-layer reflector stack,

15 the optical device component being transverse-coupled to the transmission optical
16 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
17 being adapted for enabling modal-index-matching between the transmission optical
18 waveguide and the optical device component,

19 the multi-layer waveguide structure being positioned on a substrate, layers of the multi-layer
20 waveguide structure being substantially parallel to the substrate,

21 at least one layer of the multi-layer waveguide structure being provided with a lateral lower-
22 index portion,

23 the lateral lower-index portion being provided by deposition of lower-index material.

24 40. An optical device, comprising:

25 a transmission optical waveguide; and

26 an optical device component transverse-coupled to the transmission optical waveguide so as
27 to enable optical signal power transfer therebetween,

28 the transmission optical waveguide being adapted for at least one of receiving optical signal
29 power from an optical signal transmission system and transmitting optical signal power

30 to the optical signal transmission system,

1 the optical device component including a laterally-confined multi-layer dispersion-
2 engineered waveguide structure, the multi-layer waveguide structure including at least
3 one multi-layer reflector stack,
4 the optical device component being transverse-coupled to the transmission optical
5 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
6 being adapted for enabling modal-index-matching between the transmission optical
7 waveguide and the optical device component,
8 the multi-layer waveguide structure being positioned on a substrate, layers of the multi-layer
9 waveguide structure being substantially parallel to the substrate,
10 at least one layer of the multi-layer waveguide structure being provided with a lateral lower-
11 index portion,
12 the lateral lower-index portion being provided by chemical modification of at least one
13 lateral portion of at least one layer.

14 41. An optical device, comprising:

15 a transmission optical waveguide; and
16 an optical device component transverse-coupled to the transmission optical waveguide so as
17 to enable optical signal power transfer therebetween,
18 the transmission optical waveguide being adapted for at least one of receiving optical signal
19 power from an optical signal transmission system and transmitting optical signal power
20 to the optical signal transmission system,
21 the optical device component including a laterally-confined multi-layer dispersion-
22 engineered waveguide structure, the multi-layer waveguide structure including at least
23 one multi-layer reflector stack,
24 the optical device component being transverse-coupled to the transmission optical
25 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
26 being adapted for enabling modal-index-matching between the transmission optical
27 waveguide and the optical device component,
28 the multi-layer waveguide structure being positioned on a substrate, layers of the multi-layer
29 waveguide structure being substantially perpendicular to the substrate.

- 1 42. The optical device of Claim 41, the multi-layer reflector stack comprising a distributed
2 Bragg reflector stack.
- 3 43. The optical device of Claim 41, the multi-layer waveguide structure including two multi-
4 layer reflector stacks and a core layer therebetween, the multi-layer waveguide structure
5 being thereby adapted for guiding an optical mode along the core layer.
- 6 44. The optical device of Claim 41, the multi-layer waveguide structure being formed by
7 spatially-selective processing of waveguide material deposited on the substrate.
- 8 45. The optical device of Claim 41, the transmission optical waveguide being transverse-
9 coupled to the multi-layer waveguide structure at a side surface thereof.
- 10 46. The optical device of Claim 41, the transmission optical waveguide being transverse-
11 coupled to the multi-layer waveguide structure at a top surface thereof.
- 12 47. The optical device of Claim 1, lateral confinement being provided by at least one lateral
13 grating provided in at least one layer.
- 14 48. The optical device of Claim 1, the multi-layer waveguide structure including at least one
15 dielectric multi-layer reflector stack.
- 16 49. The optical device of Claim 1, the multi-layer waveguide structure including at least one
17 semi-conductor layer.
- 18 50. The optical device of Claim 49, the multi-layer waveguide structure including alternating
19 higher-index GaAs and lower-index AlGaAs layers.
- 20 51. The optical device of Claim 50, at least one lower-index AlGaAs layer being provided with
21 at least one lateral aluminum oxide portion.
- 22 52. The optical device of Claim 49, the multi-layer waveguide structure including alternating
23 higher-index AlGaAs and lower-index aluminum oxide layers.
- 24 53. The optical device of Claim 52, at least one higher-index AlGaAs layer being provided with
25 at least one lateral aluminum oxide portion.
- 26 54. The optical device of Claim 49, the multi-layer waveguide structure including alternating
27 higher-index InP and lower-index InAlAs layers.

- 1 55. The optical device of Claim 54, at least one lower-index InAlAs layer being provided with
2 at least one lateral aluminum oxide portion.
- 3 56. The optical device of Claim 49, the multi-layer waveguide structure including alternating
4 higher-index InAlAs and lower-index aluminum oxide layers.
- 5 57. The optical device of Claim 56, at least one higher-index InAlAs layer being provided with
6 at least one lateral aluminum oxide portion.
- 7 58. The optical device of Claim 49, the multi-layer waveguide structure including alternating
8 higher-index InP and lower-index aluminum oxide layers.
- 9 59. The optical device of Claim 49, the multi-layer waveguide structure including alternating
10 higher-index GaAs and lower-index aluminum oxide layers.
- 11 60. An optical device, comprising:
12 a transmission optical waveguide; and
13 an optical device component transverse-coupled to the transmission optical waveguide so as
14 to enable optical signal power transfer therebetween,
15 the transmission optical waveguide being adapted for at least one of receiving optical signal
16 power from an optical signal transmission system and transmitting optical signal power
17 to the optical signal transmission system,
18 the optical device component including a laterally-confined multi-layer dispersion-
19 engineered waveguide structure, the multi-layer waveguide structure including at least
20 one multi-layer reflector stack,
21 the optical device component being transverse-coupled to the transmission optical
22 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
23 being adapted for enabling modal-index-matching between the transmission optical
24 waveguide and the optical device component,
25 the multi-layer waveguide structure including alternating higher-index semiconductor and
26 lower-index semiconductor layers.
- 27 61. An optical device, comprising:
28 a transmission optical waveguide; and

1 an optical device component transverse-coupled to the transmission optical waveguide so as
2 to enable optical signal power transfer therebetween,
3 the transmission optical waveguide being adapted for at least one of receiving optical signal
4 power from an optical signal transmission system and transmitting optical signal power
5 to the optical signal transmission system,
6 the optical device component including a laterally-confined multi-layer dispersion-
7 engineered waveguide structure, the multi-layer waveguide structure including at least
8 one multi-layer reflector stack,
9 the optical device component being transverse-coupled to the transmission optical
10 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
11 being adapted for enabling modal-index-matching between the transmission optical
12 waveguide and the optical device component,
13 the multi-layer waveguide structure including alternating higher-index semiconductor and
14 lower-index semiconductor layers,
15 at least one of the higher-index semiconductor layers and the lower-index semi-conductor
16 layers being provided with at least one lateral oxidized portion.

17 62. An optical device, comprising:

18 a transmission optical waveguide; and
19 an optical device component transverse-coupled to the transmission optical waveguide so as
20 to enable optical signal power transfer therebetween,
21 the transmission optical waveguide being adapted for at least one of receiving optical signal
22 power from an optical signal transmission system and transmitting optical signal power
23 to the optical signal transmission system,
24 the optical device component including a laterally-confined multi-layer dispersion-
25 engineered waveguide structure, the multi-layer waveguide structure including at least
26 one multi-layer reflector stack,
27 the optical device component being transverse-coupled to the transmission optical
28 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
29 being adapted for enabling modal-index-matching between the transmission optical
30 waveguide and the optical device component,

1 the multi-layer waveguide structure including alternating higher-index semiconductor and
2 lower-index oxide layers.

3 63. An optical device, comprising:

4 a transmission optical waveguide; and

5 an optical device component transverse-coupled to the transmission optical waveguide so as
6 to enable optical signal power transfer therebetween,

7 the transmission optical waveguide being adapted for at least one of receiving optical signal
8 power from an optical signal transmission system and transmitting optical signal power
9 to the optical signal transmission system,

10 the optical device component including a laterally-confined multi-layer dispersion-
11 engineered waveguide structure, the multi-layer waveguide structure including at least
12 one multi-layer reflector stack,

13 the optical device component being transverse-coupled to the transmission optical
14 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
15 being adapted for enabling modal-index-matching between the transmission optical
16 waveguide and the optical device component,

17 the multi-layer waveguide structure including alternating higher-index semiconductor and
18 lower-index oxide layers,

19 at least one higher-index semiconductor layer being provided with at least one lateral
20 oxidized portion.

21 64. An optical device, comprising:

22 a transmission optical waveguide; and

23 an optical device component transverse-coupled to the transmission optical waveguide so as
24 to enable optical signal power transfer therebetween,

25 the transmission optical waveguide being adapted for at least one of receiving optical signal
26 power from an optical signal transmission system and transmitting optical signal power
27 to the optical signal transmission system,

28 the optical device component including a laterally-confined multi-layer dispersion-
29 engineered waveguide structure, the multi-layer waveguide structure including at least
30 one multi-layer reflector stack,

1 the optical device component being transverse-coupled to the transmission optical
2 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
3 being adapted for enabling modal-index-matching between the transmission optical
4 waveguide and the optical device component,
5 at least one layer of the multi-layer waveguide structure including an aluminum-containing
6 semiconductor.

7 65. An optical device, comprising:

8 a transmission optical waveguide; and

9 an optical device component transverse-coupled to the transmission optical waveguide so as
10 to enable optical signal power transfer therebetween,

11 the transmission optical waveguide being adapted for at least one of receiving optical signal
12 power from an optical signal transmission system and transmitting optical signal power
13 to the optical signal transmission system,

14 the optical device component including a laterally-confined multi-layer dispersion-
15 engineered waveguide structure, the multi-layer waveguide structure including at least
16 one multi-layer reflector stack,

17 the optical device component being transverse-coupled to the transmission optical
18 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
19 being adapted for enabling modal-index-matching between the transmission optical
20 waveguide and the optical device component,

21 at least one layer of the multi-layer waveguide structure being provided with at least one
22 lateral aluminum oxide portion.

23 66. An optical device, comprising:

24 a transmission optical waveguide; and

25 an optical device component transverse-coupled to the transmission optical waveguide so as
26 to enable optical signal power transfer therebetween,

27 the transmission optical waveguide being adapted for at least one of receiving optical signal
28 power from an optical signal transmission system and transmitting optical signal power
29 to the optical signal transmission system,

the optical device component including a laterally-confined multi-layer dispersion-engineered waveguide structure, the multi-layer waveguide structure including at least one multi-layer reflector stack,

the optical device component being transverse-coupled to the transmission optical waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure being adapted for enabling modal-index-matching between the transmission optical waveguide and the optical device component,

the multi-layer waveguide structure including at least one semiconductor active layer.

67. The optical device of Claim 66, at least one semiconductor active layer being lattice-compatible with the multi-layer reflector stack.

68. The optical device of Claim 66, at least one semiconductor active layer being lattice-incompatible with the multi-layer reflector stack.

69. The optical device of Claim 66, at least one semiconductor active layer being an InGaAs layer.

70. The optical device of Claim 66, at least one semiconductor active layer being an InGaAsP layer.

71. The optical device of Claim 66, at least one semiconductor active layer being an InGaAsN layer.

72. An optical device, comprising:

a transmission optical waveguide; and

an optical device component transverse-coupled to the transmission optical waveguide so as to enable optical signal power transfer therebetween,

the transmission optical waveguide being adapted for at least one of receiving optical signal power from an optical signal transmission system and transmitting optical signal power to the optical signal transmission system,

the optical device component including a laterally-confined multi-layer dispersion-engineered waveguide structure, the multi-layer waveguide structure including at least one multi-layer reflector stack,

1 the optical device component being transverse-coupled to the transmission optical
2 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
3 being adapted for enabling modal-index-matching between the transmission optical
4 waveguide and the optical device component,
5 the multi-layer waveguide structure including at least one semiconductor active layer,
6 at least one semiconductor active layer being an electro-absorptive layer.

7 73. An optical device, comprising:

8 a transmission optical waveguide; and
9 an optical device component transverse-coupled to the transmission optical waveguide so as
10 to enable optical signal power transfer therebetween,
11 the transmission optical waveguide being adapted for at least one of receiving optical signal
12 power from an optical signal transmission system and transmitting optical signal power
13 to the optical signal transmission system,
14 the optical device component including a laterally-confined multi-layer dispersion-
15 engineered waveguide structure, the multi-layer waveguide structure including at least
16 one multi-layer reflector stack,
17 the optical device component being transverse-coupled to the transmission optical
18 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
19 being adapted for enabling modal-index-matching between the transmission optical
20 waveguide and the optical device component,
21 the multi-layer waveguide structure including at least one semiconductor active layer,
22 at least one semiconductor active layer being an electro-optic layer.

23 74. An optical device, comprising:

24 a transmission optical waveguide; and
25 an optical device component transverse-coupled to the transmission optical waveguide so as
26 to enable optical signal power transfer therebetween,
27 the transmission optical waveguide being adapted for at least one of receiving optical signal
28 power from an optical signal transmission system and transmitting optical signal power
29 to the optical signal transmission system,

1 the optical device component including a laterally-confined multi-layer dispersion-
2 engineered waveguide structure, the multi-layer waveguide structure including at least
3 one multi-layer reflector stack,
4 the optical device component being transverse-coupled to the transmission optical
5 waveguide at the multi-layer waveguide structure, the multi-layer waveguide structure
6 being adapted for enabling modal-index-matching between the transmission optical
7 waveguide and the optical device component,
8 the multi-layer waveguide structure including at least one semiconductor active layer,
9 at least one semiconductor layer being a non-linear-optic layer.

10 75. An optical modulator, comprising:

11 an input optical waveguide;
12 an output optical waveguide;
13 a first intermediate optical waveguide connecting the input and output optical waveguides;
14 and
15 a second intermediate optical waveguide connecting the input and output optical
16 waveguides,
17 the input optical waveguide being adapted for receiving optical signal power from an optical
18 signal transmission system, for dividing the received optical signal power into first and
19 second optical signal power fractions, and for transmitting the first and second optical
20 signal power fractions to the first and second intermediate optical waveguides,
21 respectively,
22 the output optical waveguide being adapted for receiving and recombining the first and
23 second optical signal power fractions from the first and second intermediate optical
24 waveguides, respectively,
25 the output optical waveguide being adapted for substantially maximally transmitting the
26 recombined optical signal power to the optical transmission system when the
27 recombined first and second optical signal fractions substantially constructively
28 interfere, and for substantially minimally transmitting the recombined optical signal
29 power to the optical transmission system when the recombined first and second optical
30 signal fractions substantially destructively interfere,

1 the input waveguide, output waveguide, first intermediate waveguide, and second
 2 intermediate waveguide each comprising a laterally-confined multi-layer dispersion-
 3 engineered waveguide structure, the multi-layer waveguide structure including at least
 4 one multi-layer reflector stack and at least one active layer, the active layer being
 5 adapted for exhibiting at least one of varying optical loss and varying modal-index in
 6 response to an applied control signal,
 7 at least one of the first and second intermediate waveguides being adapted for receiving the
 8 control signal,
 9 the multi-layer waveguide structure being adapted so that varying the control signal applied
 10 to at least one of the first and second intermediate waveguides results in a varying
 11 modal-index, thereby enabling control of interference between the recombined first and
 12 second optical signal power fractions at the output waveguide.

76. An optical modulator, comprising:

13 an input optical waveguide;
 14 an output optical waveguide;
 15 a first intermediate optical waveguide connecting the input and output optical waveguides;
 16 and
 17 a second intermediate optical waveguide connecting the input and output optical
 18 waveguides,
 19 the input waveguide, output waveguide, first intermediate waveguide, and second
 20 intermediate waveguide each including a laterally-confined multi-layer dispersion-
 21 engineered waveguide structure, the multi-layer waveguide structure including at least
 22 one multi-layer reflector stack and at least one active layer, the active layer being
 23 adapted for exhibiting at least one of varying optical loss and varying modal-index in
 24 response to a varying applied control signal,
 25 at least one of the first and second intermediate waveguides being adapted for receiving the
 26 control signal,
 27 the input optical waveguide being adapted for receiving optical signal power from an optical
 28 signal transmission system, for dividing the received optical signal power into first and
 29 second optical signal power fractions, and for transmitting the first and second optical
 30

1 signal power fractions to the first and second intermediate optical waveguides,
2 respectively,
3 the output optical waveguide being adapted for receiving and recombining the first and
4 second optical signal power fractions from the first and second intermediate optical
5 waveguides, respectively, and transmitting the recombined fractions to the optical signal
6 transmission system,
7 the optical modulator being thereby adapted so that varying the control signal level results in
8 a varying level of transmission of the recombined fractions to the optical signal
9 transmission system.

- 10 77. The optical modulator of Claim 76, the active layer including at least one electro-active
11 layer, the electro-active layer including at least one of an electro-optic layer and an electro-
12 absorptive layer, at least one of the intermediate waveguides including a pair of electrical
13 contacts with the electro-active layer therebetween, the control signal being an electrical
14 control signal applied through the electrical contacts.
- 15 78. The optical modulator of Claim 76, the active layer including at least one non-linear optical
16 layer, the control signal being an optical control signal applied to a portion of the non-linear-
17 optical layer in at least one of the intermediate waveguides.
- 18 79. The optical modulator of Claim 76, the multi-layer waveguide structure including a single
19 multi-layer waveguide stack, the multi-layer waveguide structure being thereby adapted for
20 guiding a surface-guided optical mode.
- 21 80. The optical modulator of Claim 76, the multi-layer waveguide structure including two multi-
22 layer reflector stacks and a core layer therebetween, the multi-layer waveguide structure
23 being thereby adapted for guiding an optical mode along the core layer.
- 24 81. The optical modulator of Claim 76, the input optical waveguide being adapted for receiving
25 optical signal power from the optical signal transmission system by end-coupling, the output
26 optical waveguide being adapted for transmitting optical signal power to the optical signal
27 transmission system by end-coupling.
- 28 82. An optical modulator, comprising:
29 an input optical waveguide;

1 an output optical waveguide;
2 a first intermediate optical waveguide connecting the input and output optical waveguides;
3 and
4 a second intermediate optical waveguide connecting the input and output optical
5 waveguides,
6 the input waveguide, output waveguide, first intermediate waveguide, and second
7 intermediate waveguide each including a laterally-confined multi-layer dispersion-
8 engineered waveguide structure, the multi-layer waveguide structure including at least
9 one multi-layer reflector stack and at least one active layer, the active layer being
10 adapted for exhibiting at least one of varying optical loss and varying modal-index in
11 response to a varying applied control signal,
12 at least one of the first and second intermediate waveguides being adapted for receiving the
13 control signal,
14 the input optical waveguide being adapted for receiving optical signal power from an optical
15 signal transmission system, for dividing the received optical signal power into first and
16 second optical signal power fractions, and for transmitting the first and second optical
17 signal power fractions to the first and second intermediate optical waveguides,
18 respectively,
19 the output optical waveguide being adapted for receiving and recombining the first and
20 second optical signal power fractions from the first and second intermediate optical
21 waveguides, respectively, and transmitting the recombined fractions to the optical signal
22 transmission system,
23 the optical modulator being thereby adapted so that varying the control signal level results in
24 a varying level of transmission of the recombined fractions to the optical signal
25 transmission system,
26 the input optical waveguide being adapted for receiving optical signal power from the
27 optical signal transmission system by transverse-coupling to a transmission optical
28 waveguide, the output optical waveguide being adapted for transmitting optical signal
29 power to the optical signal transmission system by transverse-coupling to a transmission
30 optical waveguide.

- 1 83. The optical modulator of Claim 82, the multi-layer waveguide structure including a high-
2 index material.
- 3 84. The optical modulator of Claim 82, the transmission optical waveguide being a low-index
4 transmission optical waveguide, the low-index waveguide being adapted for transverse-
5 coupling.
- 6 85. The optical modulator of Claim 82, the transmission optical waveguide being a transmission
7 fiber-optic waveguide, the transmission fiber-optic waveguide being adapted for transverse-
8 coupling.
- 9 86. An optical modulator, comprising:
10 an input optical waveguide;
11 an output optical waveguide;
12 a first intermediate optical waveguide connecting the input and output optical waveguides;
13 and
14 a second intermediate optical waveguide connecting the input and output optical
15 waveguides,
16 the input waveguide, output waveguide, first intermediate waveguide, and second
17 intermediate waveguide each including a laterally-confined multi-layer dispersion-
18 engineered waveguide structure, the multi-layer waveguide structure including at least
19 one multi-layer reflector stack and at least one active layer, the active layer being
20 adapted for exhibiting at least one of varying optical loss and varying modal-index in
21 response to a varying applied control signal,
22 at least one of the first and second intermediate waveguides being adapted for receiving the
23 control signal,
24 the input optical waveguide being adapted for receiving optical signal power from an optical
25 signal transmission system, for dividing the received optical signal power into first and
26 second optical signal power fractions, and for transmitting the first and second optical
27 signal power fractions to the first and second intermediate optical waveguides,
28 respectively,
29 the output optical waveguide being adapted for receiving and recombining the first and
30 second optical signal power fractions from the first and second intermediate optical

1 waveguides, respectively, and transmitting the recombined fractions to the optical signal
2 transmission system,
3 the optical modulator being thereby adapted so that varying the control signal level results in
4 a varying level of transmission of the recombined fractions to the optical signal
5 transmission system,
6 the input optical waveguide being adapted for receiving optical signal power from the
7 optical signal transmission system by transverse-coupling to a transmission optical
8 waveguide, the output optical waveguide being adapted for transmitting optical signal
9 power to the optical signal transmission system by transverse-coupling to a transmission
10 optical waveguide,
11 the transmission optical waveguide being a transmission fiber-optic waveguide including a
12 fiber-optic-taper segment, the fiber-optic-taper segment being adapted for transverse-
13 coupling.

14 87. An optical modulator, comprising:

15 an input optical waveguide;
16 an output optical waveguide;
17 a first intermediate optical waveguide connecting the input and output optical waveguides;
18 and
19 a second intermediate optical waveguide connecting the input and output optical
20 waveguides,
21 the input waveguide, output waveguide, first intermediate waveguide, and second
22 intermediate waveguide each including a laterally-confined multi-layer dispersion-
23 engineered waveguide structure, the multi-layer waveguide structure including at least
24 one multi-layer reflector stack and at least one active layer, the active layer being
25 adapted for exhibiting at least one of varying optical loss and varying modal-index in
26 response to a varying applied control signal,
27 at least one of the first and second intermediate waveguides being adapted for receiving the
28 control signal,
29 the input optical waveguide being adapted for receiving optical signal power from an optical
30 signal transmission system, for dividing the received optical signal power into first and

1 second optical signal power fractions, and for transmitting the first and second optical
2 signal power fractions to the first and second intermediate optical waveguides,
3 respectively,
4 the output optical waveguide being adapted for receiving and recombining the first and
5 second optical signal power fractions from the first and second intermediate optical
6 waveguides, respectively, and transmitting the recombined fractions to the optical signal
7 transmission system,
8 the optical modulator being thereby adapted so that varying the control signal level results in
9 a varying level of transmission of the recombined fractions to the optical signal
10 transmission system,
11 the input optical waveguide being adapted for receiving optical signal power from the
12 optical signal transmission system by transverse-coupling to a transmission optical
13 waveguide, the output optical waveguide being adapted for transmitting optical signal
14 power to the optical signal transmission system by transverse-coupling to a transmission
15 optical waveguide,
16 the transmission optical waveguide being a low-index planar lightwave transmission optical
17 waveguide, the planar lightwave transmission optical waveguide being adapted for
18 transverse-coupling.

19 88. An optical modulator, comprising:

20 a transmission optical waveguide, the transmission optical waveguide including a first
21 transverse-coupling segment, an intermediate segment, and a second transverse-
22 coupling segment; and
23 a modulator optical waveguide, the modulator optical waveguide including a first
24 transverse-coupling segment, an intermediate segment, and a second transverse-
25 coupling segment,
26 the transmission optical waveguide and the modulator optical waveguide being transverse-
27 coupled at the respective first transverse-coupling segments thereof,
28 the transmission optical waveguide and the modulator optical waveguide being transverse-
29 coupled at the respective second transverse-coupling segments thereof,

1 the transmission optical waveguide being adapted for receiving optical signal power from an
 2 optical signal transmission system into the first transverse-coupling segment thereof,
 3 the first transverse-coupling segment of the transmission optical waveguide and the first
 4 transverse-coupling segment of the modulator optical waveguide being adapted for
 5 dividing, via transverse optical coupling therebetween, the received optical signal power
 6 into a modulator waveguide fraction and a transmission waveguide fraction, and for
 7 transmitting the fractions to the respective intermediate waveguide segments,
 8 the second transverse-coupling segment of the transmission optical waveguide and the
 9 second transverse-coupling segment of the modulator optical waveguide being adapted
 10 for receiving and recombining, via transverse optical coupling, the modulator
 11 waveguide fraction and the transmission waveguide fraction,
 12 the second transverse-coupling segment of the transmission optical waveguide and the
 13 second transverse-coupling segment of the modulator optical waveguide being adapted
 14 for substantially maximally transmitting the recombined optical signal power to the
 15 optical signal transmission system when the recombined modulator waveguide fraction
 16 and transmission waveguide fraction substantially constructively interfere in the
 17 transmission optical waveguide, and for substantially minimally transmitting the
 18 recombined optical signal power to the optical signal transmission system when the
 19 recombined modulator waveguide fraction and transmission waveguide fraction
 20 substantially destructively interfere in the transmission optical waveguide,
 21 the modulator optical waveguide comprising a laterally-confined multi-layer dispersion-
 22 engineered waveguide structure, the multi-layer structure including at least one multi-
 23 layer reflector stack and at least one active layer, the active layer being adapted for
 24 exhibiting at least one of varying optical loss and varying modal-index in response to an
 25 applied control signal,
 26 the multi-layer waveguide structure being adapted so that varying the control signal applied
 27 to the intermediate waveguide segment results in a varying modal-index, thereby
 28 enabling control of interference between the recombined modulator waveguide fraction
 29 and transmission waveguide fraction in the transmission optical waveguide.

30 89. An optical modulator, comprising:

1 a transmission optical waveguide, the transmission optical waveguide including a first
2 transverse-coupling segment, an intermediate segment, and a second transverse-
3 coupling segment; and
4 a modulator optical waveguide, the modulator optical waveguide including a first
5 transverse-coupling segment, an intermediate segment, and a second transverse-
6 coupling segment,
7 the transmission optical waveguide and the modulator optical waveguide being transverse-
8 coupled at the respective first transverse-coupling segments thereof,
9 the transmission optical waveguide and the modulator optical waveguide being transverse-
10 coupled at the respective second transverse-coupling segments thereof,
11 the transmission optical waveguide being adapted for receiving optical signal power from an
12 optical signal transmission system into the first transverse-coupling segment thereof,
13 the modulator optical waveguide comprising a laterally-confined multi-layer dispersion-
14 engineered waveguide structure, the multi-layer structure including at least one multi-
15 layer reflector stack and at least one active layer, the active layer being adapted for
16 exhibiting at least one of varying optical loss and varying modal-index in response to an
17 applied control signal,
18 the first transverse-coupling segment of the transmission optical waveguide and the first
19 transverse-coupling segment of the modulator optical waveguide being adapted for
20 dividing, via transverse optical coupling therebetween, the received optical signal power
21 into a modulator waveguide fraction and a transmission waveguide fraction, and for
22 transmitting the fractions to the respective intermediate waveguide segments,
23 the second transverse-coupling segment of the transmission optical waveguide and the
24 second transverse-coupling segment of the modulator optical waveguide being adapted
25 for receiving, and recombining via transverse optical coupling the modulator waveguide
26 fraction and the transmission waveguide fraction, and transmitting the recombined
27 fractions to the optical signal transmission system,
28 the multi-layer waveguide structure being adapted so that varying the control signal applied
29 to the intermediate waveguide segment results in a varying level of transmission of the
30 recombined fractions to the optical signal transmission system.

- 1 90. The optical modulator of Claim 89, the active layer including at least one electro-active
2 layer, the electro-active layer including at least one of an electro-optic layer and an electro-
3 absorptive layer, the intermediate segment of the modulator optical waveguide including a
4 pair of electrical contacts with the electro-active layer therebetween, the control signal being
5 an electrical control signal applied through the electrical contacts.
- 6 91. The optical modulator of Claim 89, the active layer including at least one non-linear optical
7 layer, the control signal being an optical control signal applied to a portion of the non-linear-
8 optical layer in the intermediate segment of the modulator optical waveguide.
- 9 92. The optical modulator of Claim 89, the multi-layer waveguide structure including a single
10 multi-layer waveguide stack, the multi-layer waveguide structure being thereby adapted for
11 guiding a surface-guided optical mode.
- 12 93. The optical modulator of Claim 89, the multi-layer waveguide structure including two multi-
13 layer reflector stacks and a core layer therebetween, the multi-layer waveguide structure
14 being thereby adapted for guiding an optical mode along the core layer.
- 15 94. The optical modulator of Claim 89, the first transverse-coupling segment of the transmission
16 optical waveguide and the first transverse-coupling segment of the modulator optical
17 waveguide being passively substantially modal-index-matched, the second transverse-
18 coupling segment of the transmission optical waveguide and the second transverse-coupling
19 segment of the modulator optical waveguide being passively substantially modal-index-
20 matched.
- 21 95. The optical modulator of Claim 89, the first transverse-coupling segment of the transmission
22 optical waveguide and the first transverse-coupling segment of the modulator optical
23 waveguide being actively substantially modal-index-matched by applying an input control
24 signal to the active layer in the first transverse-coupling segment of the modulator optical
25 waveguide, the second transverse-coupling segment of the transmission optical waveguide
26 and the second transverse-coupling segment of the modulator optical waveguide being
27 actively substantially modal-index-matched by applying an output control signal to the
28 active layer in the second transverse-coupling segment of the modulator optical waveguide.

1 96. The optical modulator of Claim 89, the multi-layer waveguide structure including a high-
2 index material.

3 97. The optical modulator of Claim 89, the transmission optical waveguide being a low-index
4 transmission optical waveguide, the low-index waveguide being adapted for transverse-
5 coupling.

6 98. The optical modulator of Claim 89, the transmission optical waveguide being a transmission
7 fiber-optic waveguide, the transmission fiber-optic waveguide being adapted for transverse-
8 coupling.

9 99. An optical modulator, comprising:

10 a transmission optical waveguide, the transmission optical waveguide including a first
11 transverse-coupling segment, an intermediate segment, and a second transverse-
12 coupling segment; and

13 a modulator optical waveguide, the modulator optical waveguide including a first
14 transverse-coupling segment, an intermediate segment, and a second transverse-
15 coupling segment,

16 the transmission optical waveguide and the modulator optical waveguide being transverse-
17 coupled at the respective first transverse-coupling segments thereof,

18 the transmission optical waveguide and the modulator optical waveguide being transverse-
19 coupled at the respective second transverse-coupling segments thereof,

20 the transmission optical waveguide being adapted for receiving optical signal power from an
21 optical signal transmission system into the first transverse-coupling segment thereof,

22 the modulator optical waveguide comprising a laterally-confined multi-layer dispersion-
23 engineered waveguide structure, the multi-layer structure including at least one multi-
24 layer reflector stack and at least one active layer, the active layer being adapted for
25 exhibiting at least one of varying optical loss and varying modal-index in response to an
26 applied control signal,

27 the first transverse-coupling segment of the transmission optical waveguide and the first
28 transverse-coupling segment of the modulator optical waveguide being adapted for
29 dividing, via transverse optical coupling therebetween, the received optical signal power

1 into a modulator waveguide fraction and a transmission waveguide fraction, and for
 2 transmitting the fractions to the respective intermediate waveguide segments,
 3 the second transverse-coupling segment of the transmission optical waveguide and the
 4 second transverse-coupling segment of the modulator optical waveguide being adapted
 5 for receiving, and recombining via transverse optical coupling the modulator waveguide
 6 fraction and the transmission waveguide fraction, and transmitting the recombined
 7 fractions to the optical signal transmission system,
 8 the multi-layer waveguide structure being adapted so that varying the control signal applied
 9 to the intermediate waveguide segment results in a varying level of transmission of the
 10 recombined fractions to the optical signal transmission system,
 11 the transmission optical waveguide being a transmission fiber-optic waveguide including a
 12 fiber-optic-taper segment, the fiber-optic-taper segment being adapted for transverse-
 13 coupling.

14 100. An optical modulator, comprising:

15 a transmission optical waveguide, the transmission optical waveguide including a first
 16 transverse-coupling segment, an intermediate segment, and a second transverse-
 17 coupling segment; and
 18 a modulator optical waveguide, the modulator optical waveguide including a first
 19 transverse-coupling segment, an intermediate segment, and a second transverse-
 20 coupling segment,
 21 the transmission optical waveguide and the modulator optical waveguide being transverse-
 22 coupled at the respective first transverse-coupling segments thereof,
 23 the transmission optical waveguide and the modulator optical waveguide being transverse-
 24 coupled at the respective second transverse-coupling segments thereof,
 25 the transmission optical waveguide being adapted for receiving optical signal power from an
 26 optical signal transmission system into the first transverse-coupling segment thereof,
 27 the modulator optical waveguide comprising a laterally-confined multi-layer dispersion-
 28 engineered waveguide structure, the multi-layer structure including at least one multi-
 29 layer reflector stack and at least one active layer, the active layer being adapted for

1 exhibiting at least one of varying optical loss and varying modal-index in response to an
2 applied control signal,
3 the first transverse-coupling segment of the transmission optical waveguide and the first
4 transverse-coupling segment of the modulator optical waveguide being adapted for
5 dividing, via transverse optical coupling therebetween, the received optical signal power
6 into a modulator waveguide fraction and a transmission waveguide fraction, and for
7 transmitting the fractions to the respective intermediate waveguide segments,
8 the second transverse-coupling segment of the transmission optical waveguide and the
9 second transverse-coupling segment of the modulator optical waveguide being adapted
10 for receiving, and recombining via transverse optical coupling the modulator waveguide
11 fraction and the transmission waveguide fraction, and transmitting the recombined
12 fractions to the optical signal transmission system,
13 the multi-layer waveguide structure being adapted so that varying the control signal applied
14 to the intermediate waveguide segment results in a varying level of transmission of the
15 recombined fractions to the optical signal transmission system,
16 the transmission optical waveguide being a low-index planar lightwave transmission optical
17 waveguide, the planar lightwave transmission optical waveguide being adapted for
18 transverse-coupling.

19 101. An optical switch, comprising:

20 a first optical waveguide, the first optical waveguide including an input segment, a
21 transverse-coupling segment, and an output segment; and
22 a second optical waveguide, the second optical waveguide including an input segment, a
23 transverse-coupling segment, and an output segment,
24 the first and second optical waveguides being transverse-coupled at the respective
25 transverse-coupling segments thereof,
26 the input segments of the first and second optical waveguides each being adapted for
27 receiving optical signal power from an optical signal transmission system and
28 transmitting received optical signal power to the respective transverse-coupling
29 segment,

1 the output segments of the first and second optical waveguides each being adapted for
2 receiving optical signal power from the respective transverse-coupling segments and
3 transmitting the optical signal power to the optical signal transmission system,
4 the first and second optical waveguides each comprising a laterally-confined multi-layer
5 dispersion-engineered waveguide structure, the multi-layer waveguide structure
6 including at least one multi-layer reflector stack and at least one active layer, the active
7 layer being adapted for exhibiting at least one of varying optical loss and varying
8 modal-index in response to an applied control signal,
9 the multi-layer waveguide structure being adapted so that varying the control signal applied
10 to at least one of the transverse-coupling segments results in optical signal power
11 transfer between the first and second transmission optical waveguides.

12 102. The optical switch of Claim 101, the active layer including at least one electro-active layer,
13 the electro-active layer including at least one of an electro-optic layer and an electro-
14 absorptive layer, the transverse coupling segment of at least one of the optical waveguides
15 including a pair of electrical contacts with the electro-active layer therebetween, the control
16 signal being an electrical control signal applied through the electrical contacts.

17 103. The optical switch of Claim 101, the active layer including at least one non-linear optical
18 layer, the control signal being an optical control signal applied to a portion of the non-linear-
19 optical layer in the transverse-coupling segment of at least one of the optical waveguides.

20 104. The optical switch of Claim 101, the multi-layer waveguide structure including a single
21 multi-layer waveguide stack, the multi-layer waveguide structure being thereby adapted for
22 guiding a surface-guided optical mode.

23 105. The optical switch of Claim 101, the multi-layer waveguide structure including two multi-
24 layer reflector stacks and a core layer therebetween, the multi-layer waveguide structure
25 being thereby adapted for guiding an optical mode along the core layer.

26 106. The optical switch of Claim 101, the input segments of the first and second optical
27 waveguides being adapted for receiving optical signal power from the optical signal
28 transmission system by end-coupling, the output segments of the first and second optical

1 waveguides being adapted for transmitting optical signal power to the optical signal
2 transmission system by end-coupling.

3 107. An optical switch, comprising:

4 a first optical waveguide, the first optical waveguide including an input segment, a
5 transverse-coupling segment, and an output segment; and
6 a second optical waveguide, the second optical waveguide including an input segment, a
7 transverse-coupling segment, and an output segment,
8 the first and second optical waveguides being transverse-coupled at the respective
9 transverse-coupling segments thereof,
10 the input segments of the first and second optical waveguides each being adapted for
11 receiving optical signal power from an optical signal transmission system and
12 transmitting received optical signal power to the respective transverse-coupling
13 segment,
14 the output segments of the first and second optical waveguides each being adapted for
15 receiving optical signal power from the respective transverse-coupling segments and
16 transmitting the optical signal power to the optical signal transmission system,
17 the first and second optical waveguides each comprising a laterally-confined multi-layer
18 dispersion-engineered waveguide structure, the multi-layer waveguide structure
19 including at least one multi-layer reflector stack and at least one active layer, the active
20 layer being adapted for exhibiting at least one of varying optical loss and varying
21 modal-index in response to an applied control signal,
22 the multi-layer waveguide structure being adapted so that varying the control signal applied
23 to at least one of the transverse-coupling segments results in optical signal power
24 transfer between the first and second transmission optical waveguides,
25 the input segments of the first and second optical waveguides being adapted for receiving
26 optical signal power from the optical signal transmission system by transverse-coupling
27 to a transmission optical waveguide, the output segments of the first and second optical
28 waveguides being adapted for transmitting optical signal power to the optical signal
29 transmission system by transverse coupling to a transmission optical waveguide.

1 108. The optical switch of Claim 107, the multi-layer waveguide structure including a high-index
2 material.

3 109. The optical switch of Claim 107, the transmission optical waveguide being a low-index
4 transmission optical waveguide, the low-index waveguide being adapted for transverse-
5 coupling.

6 110. The optical switch of Claim 107, the transmission optical waveguide being a transmission
7 fiber-optic waveguide, the transmission fiber-optic waveguide being adapted for transverse-
8 coupling.

9 111. An optical switch, comprising:

10 a first optical waveguide, the first optical waveguide including an input segment, a
11 transverse-coupling segment, and an output segment; and
12 a second optical waveguide, the second optical waveguide including an input segment, a
13 transverse-coupling segment, and an output segment,
14 the first and second optical waveguides being transverse-coupled at the respective
15 transverse-coupling segments thereof,
16 the input segments of the first and second optical waveguides each being adapted for
17 receiving optical signal power from an optical signal transmission system and
18 transmitting received optical signal power to the respective transverse-coupling
19 segment,
20 the output segments of the first and second optical waveguides each being adapted for
21 receiving optical signal power from the respective transverse-coupling segments and
22 transmitting the optical signal power to the optical signal transmission system,
23 the first and second optical waveguides each comprising a laterally-confined multi-layer
24 dispersion-engineered waveguide structure, the multi-layer waveguide structure
25 including at least one multi-layer reflector stack and at least one active layer, the active
26 layer being adapted for exhibiting at least one of varying optical loss and varying
27 modal-index in response to an applied control signal,
28 the multi-layer waveguide structure being adapted so that varying the control signal applied
29 to at least one of the transverse-coupling segments results in optical signal power
30 transfer between the first and second transmission optical waveguides,

1 the input segments of the first and second optical waveguides being adapted for receiving
2 optical signal power from the optical signal transmission system by transverse-coupling
3 to a transmission optical waveguide, the output segments of the first and second optical
4 waveguides being adapted for transmitting optical signal power to the optical signal
5 transmission system by transverse coupling to a transmission optical waveguide,
6 the transmission optical waveguide being a transmission fiber-optic waveguide including a
7 fiber-optic-taper segment, the fiber-optic-taper segment being adapted for transverse-
8 coupling.

9 112. An optical switch, comprising:

10 a first optical waveguide, the first optical waveguide including an input segment, a
11 transverse-coupling segment, and an output segment; and
12 a second optical waveguide, the second optical waveguide including an input segment, a
13 transverse-coupling segment, and an output segment,
14 the first and second optical waveguides being transverse-coupled at the respective
15 transverse-coupling segments thereof,
16 the input segments of the first and second optical waveguides each being adapted for
17 receiving optical signal power from an optical signal transmission system and
18 transmitting received optical signal power to the respective transverse-coupling
19 segment,
20 the output segments of the first and second optical waveguides each being adapted for
21 receiving optical signal power from the respective transverse-coupling segments and
22 transmitting the optical signal power to the optical signal transmission system,
23 the first and second optical waveguides each comprising a laterally-confined multi-layer
24 dispersion-engineered waveguide structure, the multi-layer waveguide structure
25 including at least one multi-layer reflector stack and at least one active layer, the active
26 layer being adapted for exhibiting at least one of varying optical loss and varying
27 modal-index in response to an applied control signal,
28 the multi-layer waveguide structure being adapted so that varying the control signal applied
29 to at least one of the transverse-coupling segments results in optical signal power
30 transfer between the first and second transmission optical waveguides,

1 the input segments of the first and second optical waveguides being adapted for receiving
2 optical signal power from the optical signal transmission system by transverse-coupling
3 to a transmission optical waveguide, the output segments of the first and second optical
4 waveguides being adapted for transmitting optical signal power to the optical signal
5 transmission system by transverse coupling to a transmission optical waveguide,
6 the transmission optical waveguide being a low-index planar lightwave transmission optical
7 waveguide, the planar lightwave transmission optical waveguide being adapted for
8 transverse-coupling.

9 113. A resonant optical device, comprising:

10 a transmission optical waveguide; and

11 an optical resonator transverse-coupled to the transmission optical waveguide so as to enable
12 optical signal power transfer therebetween,

13 the transmission optical waveguide being adapted for at least one of receiving optical signal
14 power from an optical signal transmission system and transmitting optical signal power
15 to the optical signal transmission system,

16 the optical resonator including a laterally-confined multi-layer dispersion-engineered
17 waveguide structure, the multi-layer waveguide structure including at least one multi-
18 layer reflector stack and at least one active layer, the active layer being adapted for
19 exhibiting at least one of varying optical loss and varying modal-index in response to an
20 applied control signal,

21 the optical resonator being transverse-coupled to the transmission optical waveguide through
22 the multi-layer waveguide structure, the multi-layer waveguide structure being adapted
23 for enabling control, by application of a control signal, of at least one of optical signal
24 power transfer between the transmission optical waveguide and the optical resonator, a
25 resonant frequency of the optical resonator, and optical loss of the optical resonator,
26 thereby further enabling modulation of transmission of optical signal power through the
27 transmission optical waveguide when the optical signal is substantially resonant with
28 the optical resonator.

29 114. The optical modulator of Claim 113, the active layer including at least one electro-active
30 layer, the electro-active layer including at least one of an electro-optic layer and an electro-

1 absorptive layer, the optical resonator including a pair of electrical contacts with at least a
2 portion of the electro-active layer therebetween, the control signal being an electrical control
3 signal applied through the electrical contacts.

4 115. The optical modulator of Claim 113, the active layer including at least one non-linear optical
5 layer, the control signal being an optical control signal applied to the non-linear-optical layer
6 in at least a portion of the optical resonator.

7 116. The optical modulator of Claim 113, the multi-layer waveguide structure including a single
8 multi-layer waveguide stack, the multi-layer waveguide structure being thereby adapted for
9 guiding a surface-guided optical mode.

10 117. The optical modulator of Claim 113, the multi-layer waveguide structure including two
11 multi-layer reflector stacks and a core layer therebetween, the multi-layer waveguide
12 structure being thereby adapted for guiding an optical mode along the core layer.

13 118. The optical modulator of Claim 113, the optical resonator and the transmission optical
14 waveguide being passively substantially modal-index-matched at respective transverse-
15 coupling segments thereof.

16 119. The optical modulator of Claim 113, the optical resonator and the transmission optical
17 waveguide being actively substantially modal-index-matched at respective transverse-
18 coupling segments thereof by applying a control signal to the active layer in the transverse-
19 coupling segment of the optical resonator.

20 120. The optical modulator of Claim 113, the multi-layer waveguide structure including a high-
21 index material.

22 121. The optical modulator of Claim 113, the transmission optical waveguide being a low-index
23 transmission optical waveguide, the low-index waveguide being adapted for transverse-
24 coupling.

25 122. The optical modulator of Claim 113, the transmission optical waveguide being a
26 transmission fiber-optic waveguide, the transmission fiber-optic waveguide being adapted
27 for transverse-coupling.

28 123. A resonant optical device, comprising:

1 a transmission optical waveguide; and
2 an optical resonator transverse-coupled to the transmission optical waveguide so as to enable
3 optical signal power transfer therebetween,
4 the transmission optical waveguide being adapted for at least one of receiving optical signal
5 power from an optical signal transmission system and transmitting optical signal power
6 to the optical signal transmission system,
7 the optical resonator including a laterally-confined multi-layer dispersion-engineered
8 waveguide structure, the multi-layer waveguide structure including at least one multi-
9 layer reflector stack and at least one active layer, the active layer being adapted for
10 exhibiting at least one of varying optical loss and varying modal-index in response to an
11 applied control signal,
12 the optical resonator being transverse-coupled to the transmission optical waveguide through
13 the multi-layer waveguide structure, the multi-layer waveguide structure being adapted
14 for enabling control, by application of a control signal, of at least one of optical signal
15 power transfer between the transmission optical waveguide and the optical resonator, a
16 resonant frequency of the optical resonator, and optical loss of the optical resonator,
17 thereby further enabling modulation of transmission of optical signal power through the
18 transmission optical waveguide when the optical signal is substantially resonant with
19 the optical resonator,
20 the transmission optical waveguide being a transmission fiber-optic waveguide including a
21 fiber-optic-taper segment, the fiber-optic-taper segment being adapted for transverse-
22 coupling.

23 124.A resonant optical device, comprising:

24 a transmission optical waveguide; and
25 an optical resonator transverse-coupled to the transmission optical waveguide so as to enable
26 optical signal power transfer therebetween,
27 the transmission optical waveguide being adapted for at least one of receiving optical signal
28 power from an optical signal transmission system and transmitting optical signal power
29 to the optical signal transmission system,

1 the optical resonator including a laterally-confined multi-layer dispersion-engineered
2 waveguide structure, the multi-layer waveguide structure including at least one multi-
3 layer reflector stack and at least one active layer, the active layer being adapted for
4 exhibiting at least one of varying optical loss and varying modal-index in response to an
5 applied control signal,
6 the optical resonator being transverse-coupled to the transmission optical waveguide through
7 the multi-layer waveguide structure, the multi-layer waveguide structure being adapted
8 for enabling control, by application of a control signal, of at least one of optical signal
9 power transfer between the transmission optical waveguide and the optical resonator, a
10 resonant frequency of the optical resonator, and optical loss of the optical resonator,
11 thereby further enabling modulation of transmission of optical signal power through the
12 transmission optical waveguide when the optical signal is substantially resonant with
13 the optical resonator,
14 the transmission optical waveguide being a low-index planar lightwave transmission optical
15 waveguide, the planar lightwave transmission optical waveguide being adapted for
16 transverse-coupling.

17 125. A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
18 waveguide structure, comprising the steps of:
19 depositing a layer structure on a substrate, the layer structure including a multi-layer
20 reflector stack and an active layer; and
21 spatially-selectively processing at least a portion of at least one of the multi-layer reflector
22 stack and the active layer so as to provide lateral confinement for a guided optical
23 mode.

24 126. The method of Claim 125, further including the step of processing at least one side of the
25 multi-layer waveguide structure to provide at least one layer of the multi-layer waveguide
26 structure with at least one lateral lower-index portion.

27 127. A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
28 waveguide structure, comprising the steps of:
29 depositing a layer structure on a substrate, the layer structure including a multi-layer
30 reflector stack and an active layer;

1 spatially-selectively processing at least a portion of at least one of the multi-layer reflector
2 stack and the active layer so as to provide lateral confinement for a guided optical
3 mode; and
4 processing at least one side of the multi-layer waveguide structure to provide at least one
5 layer of the multi-layer waveguide structure with at least one lateral lower-index
6 portion,
7 the lateral lower-index portion being provided by oxidation of a lateral portion of the layer.

8 128.A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
9 waveguide structure, comprising the steps of:
10 depositing a first layer structure on a first substrate, the first layer structure including a
11 multi-layer reflector stack;
12 depositing a second layer structure on a second substrate, the second layer structure
13 including an active layer;
14 securedly positioning the second substrate relative to the first substrate so as to substantially
15 eliminate voids between the first and second layer structures;
16 removing the second substrate while leaving the at least a portion of the second layer
17 structure; and
18 spatially-selectively processing at least a portion of at least one of the first and second layer
19 structures so as to provide lateral confinement for a guided optical mode.

20 129.The method of Claim 128, further including the step of processing at least one side of the
21 multi-layer waveguide structure to provide at least one layer thereof with at least one lateral
22 lower-index portion thereof.

23 130.A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
24 waveguide structure, comprising the steps of:
25 depositing a first layer structure on a first substrate, the first layer structure including a
26 multi-layer reflector stack;
27 depositing a second layer structure on a second substrate, the second layer structure
28 including an active layer;
29 securedly positioning the second substrate relative to the first substrate so as to substantially
30 eliminate voids between the first and second layer structures;

1 removing the second substrate while leaving the at least a portion of the second layer
2 structure;
3 spatially-selectively processing at least a portion of at least one of the first and second layer
4 structures so as to provide lateral confinement for a guided optical mode; and
5 processing at least one side of the multi-layer waveguide structure to provide at least one
6 layer thereof with at least one lateral lower-index portion thereof,
7 the lateral lower-index portion being provided by oxidation of a portion of the layer.

8 131. A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
9 waveguide structure, comprising the steps of:
10 depositing a layer structure on a substrate, the layer structure including a first multi-layer
11 reflector stack, a second multi-layer reflector stack, a core layer therebetween, and an
12 active layer; and
13 spatially-selectively processing at least one of the first and second multi-layer-reflector
14 stacks, the core layer, and the active layer, thereby providing lateral confinement for a
15 guided optical mode.

16 132. The method of Claim 131, further including the step of processing at least one side of the
17 multi-layer waveguide structure to provide at least one layer thereof with at least one lateral
18 lower-index portion thereof.

19 133. A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
20 waveguide structure, comprising the steps of:
21 depositing a layer structure on a substrate, the layer structure including a first multi-layer
22 reflector stack, a second multi-layer reflector stack, a core layer therebetween, and an
23 active layer;
24 spatially-selectively processing at least one of the first and second multi-layer-reflector
25 stacks, the core layer, and the active layer, thereby providing lateral confinement for a
26 guided optical mode; and
27 processing at least one side of the multi-layer waveguide structure to provide at least one
28 layer thereof with at least one lateral lower-index portion thereof,
29 the lateral lower-index portion being provided by oxidation of a portion of the layer.

1 134. A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
2 waveguide structure, comprising the steps of:
3 depositing a first layer structure on a first substrate, the first layer structure including a first
4 multi-layer reflector stack;
5 depositing a second layer structure on a second substrate, the second layer structure
6 including a second multi-layer reflector stack, at least one of the first and second layer
7 structures including a core layer, at least one of the first and second layer structures
8 including an active layer;
9 securedly positioning the second substrate relative to the first substrate so as to substantially
10 eliminate voids between the first and second layer structures and so as to position the
11 core layer between the first and second multi-layer reflector stacks;
12 removing one of the first and second substrates while leaving at least a portion of each of the
13 first multi-layer reflector stack, the core, the second multi-layer reflector stack, and the
14 active layer; and
15 spatially-selectively processing at least one of the first multi-layer reflector stack, the core
16 layer, the second multi-layer reflector stack, and the active layer, thereby providing
17 lateral confinement for a guided optical mode.

18 135. The method of Claim 134, further including the step of processing at least one side of the
19 multi-layer waveguide structure to provide at least one layer thereof with at least one lateral
20 lower-index portion thereof.

21 136. A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
22 waveguide structure, comprising the steps of:
23 depositing a first layer structure on a first substrate, the first layer structure including a first
24 multi-layer reflector stack;
25 depositing a second layer structure on a second substrate, the second layer structure
26 including a second multi-layer reflector stack, at least one of the first and second layer
27 structures including a core layer, at least one of the first and second layer structures
28 including an active layer;

1 securedly positioning the second substrate relative to the first substrate so as to substantially
 2 eliminate voids between the first and second layer structures and so as to position the
 3 core layer between the first and second multi-layer reflector stacks;
 4 removing one of the first and second substrates while leaving at least a portion of each of the
 5 first multi-layer reflector stack, the core, the second multi-layer reflector stack, and the
 6 active layer;
 7 spatially-selectively processing at least one of the first multi-layer reflector stack, the core
 8 layer, the second multi-layer reflector stack, and the active layer, thereby providing
 9 lateral confinement for a guided optical mode; and
 10 processing at least one side of the multi-layer waveguide structure to provide at least one
 11 layer thereof with at least one lateral lower-index portion thereof,
 12 the lateral lower-index portion being provided by oxidation of a portion of the layer.

13 137. A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
 14 waveguide structure on a substrate, comprising the steps of:
 15 depositing a first layer structure on a first substrate, the first layer structure including a first
 16 multi-layer reflector stack;
 17 depositing a second layer structure on a second substrate, the second layer structure
 18 including a second multi-layer reflector stack;
 19 depositing third layer structure on a third substrate, the third layer structure including an
 20 active layer, at least one of the first, second, and third layer structures including a core
 21 layer;
 22 securedly positioning the third substrate relative to the first substrate so as to substantially
 23 eliminate voids between the first and third layer structures;
 24 removing the third substrate while leaving at least a portion of the active layer;
 25 securedly positioning the second substrate relative to the first substrate so as to substantially
 26 eliminate voids between the second and third layer structures and so as to position the
 27 core layer between the first and second multi-layer reflector stacks;
 28 removing the second substrate while leaving at least a portion of the second multi-layer
 29 reflector stack; and

1 spatially-selectively processing at least one of the first multi-layer reflector stack, the core
2 layer, the second multi-layer reflector stack, and the active layer, thereby providing
3 lateral confinement for a guided optical mode.

4 138. The method of Claim 137, further including the step of processing at least one side of the
5 multi-layer waveguide structure to provide at least one layer thereof with at least one lateral
6 lower-index portion thereof.

7 139. A method for fabricating a multi-layer laterally-confined dispersion-engineered optical
8 waveguide structure on a substrate, comprising the steps of:
9 depositing a first layer structure on a first substrate, the first layer structure including a first
10 multi-layer reflector stack;
11 depositing a second layer structure on a second substrate, the second layer structure
12 including a second multi-layer reflector stack;
13 depositing third layer structure on a third substrate, the third layer structure including an
14 active layer, at least one of the first, second, and third layer structures including a core
15 layer;
16 securedly positioning the third substrate relative to the first substrate so as to substantially
17 eliminate voids between the first and third layer structures;
18 removing the third substrate while leaving at least a portion of the active layer;
19 securedly positioning the second substrate relative to the first substrate so as to substantially
20 eliminate voids between the second and third layer structures and so as to position the
21 core layer between the first and second multi-layer reflector stacks;
22 removing the second substrate while leaving at least a portion of the second multi-layer
23 reflector stack;
24 spatially-selectively processing at least one of the first multi-layer reflector stack, the core
25 layer, the second multi-layer reflector stack, and the active layer, thereby providing
26 lateral confinement for a guided optical mode; and
27 processing at least one side of the multi-layer waveguide structure to provide at least one
28 layer thereof with at least one lateral lower-index portion thereof,
29 the lateral lower-index portion being provided by oxidation of a portion of the layer.